

An Empirical Approach to Aerosol Model Development for Radiative Transfer Calculations

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Closure studies quantify how well we can predict the radiative impact of aerosols and ultimately their effect on climate. To obtain closure, radiative transfer models must incorporate representative aerosol optical properties which, in reality, change on time scales of hours to days depending on their source and chemistry. Typically, standard aerosol properties are used as model inputs that are not necessarily representative of an aerosol type at a particular time or location, causing error in radiative flux estimates for that location. In situ measurements of aerosol properties are made at various locations around the globe but extraction of the required properties can be time consuming. Long-term observations (1998-2002) made by CMDL were used to classify aerosol types from two ARM sites: Southern Great Plains at Lamont, Oklahoma, (SGP) (midlatitude continental) and North Slope of Alaska (NSA) at Barrow (Arctic marine). Distinct aerosol types have been extracted from these data sets using cluster analysis with in situ observations of aerosol chemistry, optical properties, and local meteorology. The fundamental aerosol types at each site are presented as well as a time series and the range of values for properties relevant to radiative transfer modeling (Figure 1). Information from isentropic air trajectory analysis from each of the sites is used to further characterize the different aerosol types. Finally, a comparison is given between these results and a standard aerosol model. The data-driven models can be used to illustrate the amount of aerosol-induced uncertainty in radiative transfer calculations based on the specification of generalized aerosol types rather than measurements and can be useful in quantifying the extent of closure between measurements and model calculations. They are also intended to provide a reasonable set of model inputs for determining radiative impacts at these sites.

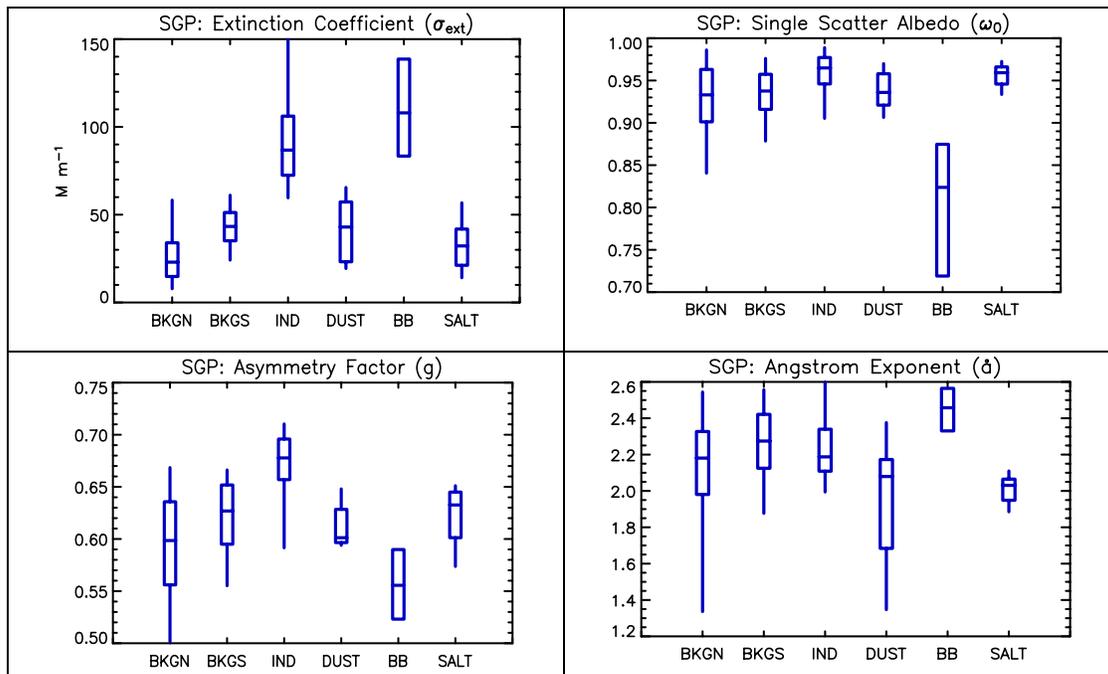


Figure 1. Range of values for selected optical properties for the six aerosol types identified at SGP. The middle line of the box represents the median value, the top and bottom of the box the 75th and 25th percentile values, and the top and bottom of the whiskers the 95th and 5th percentile values.